Weekly Report

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1 Project

This week, I was working on searching solutions for parallel visualization in our Climate Visualization project. After reading papers [1, 2], I found that the open-source parallel rendering framework **Equalizer** (http://www.equalizergraphics.com/) can be potentially employed in our project. Roughly speaking, **Equalizer**is the standard middleware to create and deploy parallel OpenGL-based applications. However, more details on this framework need to be dug out, for example the support of semi-transparent rendering, volume rendering, and the most important part hybrid rendering. If theses features are not supported in this framework, we have to investigate and balance the efforts of implementing these features based on this framework. Furthermore, **Chromium** (http://chromium.sourceforge.net/) which is a system for interactive rendering on clusters of graphics workstations need us to pay more attention. We can borrow the core architecture of this system.
Besides, I was reading the materials on the architecture design of parallel rendering engined provided by Zhen Liu.

2 Research

In this week, my research work did go very well. Due to more attention paid to parallel visualization engine, I only came up with three research ideas for further discussion, more details can be found in my summary slides. The revision of the rejected vis paper did not go far.

3 Work to do in next week

- Investigate the architecture and source code of **Equalizer**
- Revise the rejected vis paper especially the experiments of U.S. crime rate dataset

References

[1] Stefan Eilemann, Maxim Makhinya, and Renato Pajarola. Equalizer: A scalable parallel rendering framework. *Visualization and Computer Graphics, IEEE Transactions on*, 15(3):436–452, 2009.

[2] Stefan Eilemann, Ahmet Bilgili, Marwan Abdellah, Juan Hernando, Maxim Makhinya, Renato Pajarola, and Felix Schürmann. Parallel rendering on hybrid multi-gpu clusters. In *EGPGV*, pages 109–117, 2012.

[3] Xiaofei He, Ming Ji, and Hujun Bao. A unified active and semi-supervised learning framework for image compression. In *Computer Vision and Pattern Recognition, 2009. CVPR 2009. IEEE Conference on*, pages 65–72. IEEE, 2009.

基于机器学习的数据压缩

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图片着色

- YUV颜色空间
  - Y -> U, V
- 目标函数
  - **r, s**表示两个像素
  - ***Y(r)***已知
  - ***U(r), V(r)***部分已知

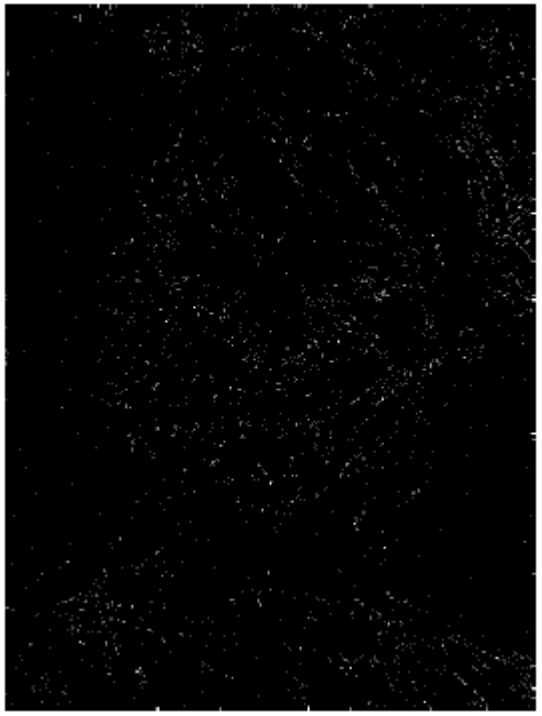
$$J(U) = \sum_{\mathbf{r}} \left(U(\mathbf{r}) - \sum_{\mathbf{s} \in N(\mathbf{r})} w_{\mathbf{rs}} U(\mathbf{s}) \right)^2$$

$$w_{\mathbf{rs}} \propto e^{-(Y(\mathbf{r}) - Y(\mathbf{s}))^2 / 2\sigma_{\mathbf{r}}^2}$$

[Siggraph 2004] Colorization using Optimization



图像压缩（机器学习）



图像压缩（机器学习）

- 基本假设
  - 特征空间（灰度图）中相邻点具有相同的颜色属性
- 压缩
  - 半监督学习
- 解压缩

图像压缩（机器学习）

- 压缩
  - ① 构建灰度图（原始数据的特征场）

图像压缩（机器学习）

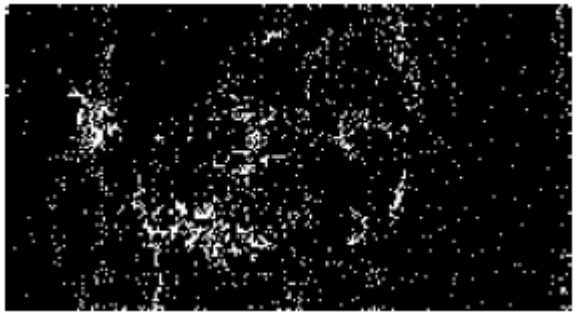
- 压缩
  1. 构建灰度图（原始数据的特征场）
  2. 选取代表点
     - 随机法
     - 主动学习法
       a) 对图片进行过分割
       b) 在每个分割区域中随机选取一个点作为代表点
       c) 构建优化的Graph
       d) 求解得到f

$$J(f) = c\,||f||_{\mathcal{H}}^2 + \frac{\lambda}{n^2}\,||f||_{\mathcal{G}}^2 + \frac{1}{m}\sum_{i=1}^{m} l(\boldsymbol{x}_i, y_i, f)$$

$$f(\cdot) = \sum_{i=1}^{n} \alpha_i k(\boldsymbol{x}_i, \cdot)$$

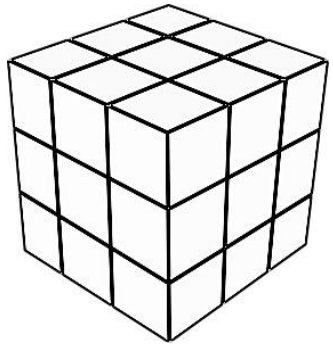
       e) 用f验证每个区域的错误，错误高的区域增加采样，并返回b)，知道误差低于给定阈值



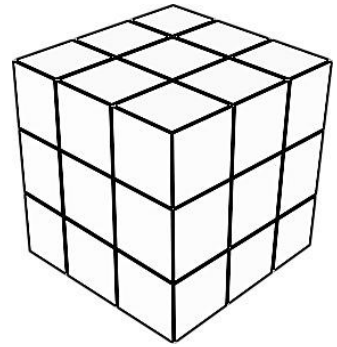


体数据压缩思想

- 基本假设依旧成立
  - 特征空间中相邻点具有相似的体素值
- 特征空间定义
  - unsigned char体数据
- 块化
  - 构建层次化的体数据结构
- 选取代表点
  - 在每个块中随机选取一个体素作为代表点
- 构建KNN邻近图
  - 不仅考虑体素的集合位置信息还考虑体素值
- Training



原始浮点体数据



unsigned char体数据

图像压缩（机器学习）

- 压缩
  - ① 选取代表点
    - 随机法
    - 对图像过分割，随机选取分割结果中的点
    - 主动学习的方法选取代表点
  - 在灰度图中构建KNN网络
  - Graph-based semi-supervised方法生成一个预测函数
- 解压缩

体数据压缩思想

- 压缩比分析
  - 层次化结构可节省部分空间
  - unsigned char可节省3/4的空间
- 有损率分析
  - 未知